Abstract

This study explored the relation between athletes' sleep quality and imagery ability. A total of 201 athletes (39.3% female, 60.7% male; M_{age} = 23.28 years, *SD* = 6.00) completed the Sport Imagery Ability Questionnaire (SIAQ) and the Pittsburgh Sleep Quality Index (PSQI). Simple regression analyses revealed that global sleep quality predicted affect imagery ability. Multiple regression analyses revealed that daytime dysfunction predicted global imagery ability as well as skill, strategy, affect, and mastery imagery ability dimensions. In addition, use of sleeping medication predicted global imagery ability, as well as goal and affect imagery ability dimensions. Results provide some support for Cumming and Williams' (2012) revised applied model of deliberate imagery use, suggesting that individual factors influence the effectiveness of imagery use. Specifically, athletes who have no disruption to daily functioning due to sleep find it easier to image sport-related content.

Key words: athletes, sleep quality, imagery ability, revised applied model of deliberate imagery use

The Effects of Sleep Quality on Imagery Ability in Athletic Populations

Imagery is possibly the most cited intervention method in sport psychology literature, with a total of 245 academic papers in the last 5 years alone addressing this topic (search completed on SportDiscus using search terms “imagery” AND “sport”, and limited to academic journals). White and Hardy (1998) describe11 imagery as “an experience that mimics real experience. We can be aware of “seeing” an image, feeling movements as an image, or experiencing the real thing… It differs from dreams in that we are awake and conscious when we form an image” (p. 389). In sport, imagery refers to the mental representation of sport relevant actions, and has been associated with changes in cognitions, behaviors and thoughts in athletic populations (Martin, Moritz, & Hall, 1999).

Over the past two decades, sport-based imagery research has focused on the five types of imagery outlined in Paivio’s (1985) conceptual framework and the Sport Imagery Questionnaire (Hall, Mack, Paivio & Hausenblas, 1998): (1) cognitive-specific (imagery of specific sport skills), (2) cognitive general (imagery of strategies/tactical plays), (3) motivational specific (imagery of specific goal orientated behaviors), (4) motivational general-mastery (imagery of effective coping and mastery of challenging situations), and (5) motivational general-arousal (imagery that represents feelings of relaxation, stress, arousal and anxiety). Investigations into imagery practice and effectiveness have explored a plethora of factors including the impact of sporting ability and experience (e.g., Gregg & Hall, 2006), different theoretical approaches or modus operandi (e.g., Wright & Smith, 2009), and different imagery types and their relationship to other psychological constructs (e.g., Cumming, Olphin, & Law, 2007; Shearer, Thomson, Mellalieu, & Shearer, 2007). One of the most explored factors in sport imagery literature is that of imagery ability (e.g., Gregg, Hall, McGowan, & Hall, 2011; Wilson, Smith, Burden, & Holmes, 2010, Williams & Cumming, 2012), which can be defined as “an individual’s capability to form vivid, controllable images and retain them for sufficient time to effect the desired imagery rehearsal” (Morris, Spittle, & Watt, 2005, p. 37).

In 2012, Cumming and Williams introduced the revised applied model of deliberate imagery use, which extended from Martin, Moritz and Hall’s (1999) widely adopted original model in four ways. First, the revised applied model acknowledges the importance of the individual performing the imagery (who), placing particular emphasis on individual characteristics that may influence imagery function and effectiveness. Second, the revised applied model distinguishes between the type of imagery (what) and the function that it is used for (why), suggesting that a specific imagery type can serve different functions depending on the meaning associated with the imagery content. Third, the revised applied model clarifies the role of imagery ability, outlining its impact on what and how an individual images, as well as the outcomes associated with imagery use. Finally, the revised applied model accounts for the diverse application of imagery, outlining how imagery interventions can be used across domains such as dance, exercise, and rehabilitation in addition to sport.

Paivio (1986) outlined that all athletes have the capacity to image to some extent, but that imagery ability will vary across individuals (i.e., a person may be more/less able to generate imagery) and within individuals subject to the imagery content (i.e., a person may be more able to generate cognitive versus motivational images). This is in keeping with the “who” aspects outlined in Cumming and Williams’ (2012) model, which suggest that individual factors such as age, gender, competitive level, and psychological traits and states will impact upon imagery effectiveness (Cumming & Williams, 2013). Indeed, several factors are thought to relate to imagery ability, including athletic experience (Abma, Fry, Li, & Relyea, 2002), emotion regulation (Anuar, Cumming, & Williams, 2016), observation and movement priming (Williams, Cumming, & Edwards, 2011), and corticospinal activation (Williams, Pearce, Loporto, Morris, & Holmes, 2012). However, no consensus exists concerning the factors that might affect athletes' ability to generate effective images and to the best of our knowledge no research has explored the impact of physiological factors associated with recovery status (e.g., sleep quality) upon imagery ability.

Sleep is an essential requirement for all basic human functions (Dattilo et al., 2011; Meerlo, Sgoifo, & Suchecki, 2008) and is known to affect the autonomic nervous system, endocrine system, and biochemical function when disrupted (e.g., Spiegel, Leproult, & Van Cauter, 1999). From a psychological perspective, poor sleep also effects cognitive factors (e.g., Belenky et al., 2003) and mood states (e.g., Sinnerton & Reilly, 1992) and is therefore likely to contribute to poor decision making and motivation to train (either physically or mentally). Restricted sleep is a known problem in modern society (Meerlo et al., 2008), and also within elite athlete populations (e.g., Leeder, Glaister, Pizzoferro, Dawson, & Pedlar, 2012). This restriction is down to a combination of lifestyle (e.g., unsocial working hours), behavioral (e.g., poor sleep hygiene), and psychological factors (e.g., perceived stress level). In addition, athletes specifically suffer disruptions as a direct function of their sporting activity. Research demonstrates that training volume (Jürimäe, Mäestu, Purge, & Jürimäe, 2004), training times (Sargent, Halson, & Roach, 2014), and competition all impact on athletes sleep quality (Shearer, Jones, Kilduff, & Cook, 2015).

Sleep is reported to impact attention, working memory, long-term memory, motivation, and visuo-motor performance, outlining its importance towards cognitive functioning (see Alhola & Polo-Kantola, 2007 for a review). There is also consistent support, spanning behavioral and neurophysiological studies, for the role of sleep in memory consolidation (see Stickgold, 2005 for a review). The role of memory in the generation of mental imagery is well explained from both a theoretical and empirical standpoint (Paivio 1985; Tong, 2013). Therefore, the relationship that both sleep and imagery hold with memory indicates that sleep will impact an individual's ability to generate imagery.

In general terms, the topics of imagery and sleep have often been considered together in the literature. For instance, there is some evidence that sleep plays an important role in the consolidation of learning following a motor imagery intervention (Debarnot, Creveaux, Collet, Doyon, & Guillot, 2009; Debarnot et al., 2009). In addition, imagery has been used as an intervention to treat sleep nightmares in patients with Post Traumatic Stress Disorder (e.g., Berlin, Means, & Edinger, 2010; Harb, Thompson, Ross, & Cook, 2012). However, to our knowledge in athletic populations or otherwise, no research has considered how sleep quality effects imagery ability. Imagery ability is likely impacted by the quality of sleep due to the effect poor sleep has on cognitive factors such as attention (e.g., Belenky et al., 2003), and motivational factors such as mood states (e.g., Sinnerton & Reilly, 1992). The aim of this study was to explore the relationship between the imagery ability of specific imagery types (cf. Williams & Cumming, 2011) and sleep quality in an athletic population ranging in ability from amateur to elite/international and professional. Based on a number of individual characteristics influencing imagery effectiveness for athletes (e.g., emotional regulation; Anuar et al., 2016) and the apparent influence of sleep on outcomes associated with imagery (e.g., learning consolidation; Debarnot et al., 2009), it was hypothesized that global sleep quality and the seven components of sleep quality will predict imagery ability in athletic populations.

Method

Participants

Participants (N = 201, females = 79, males = 122; M_{age} = 23.28 years, SD = 6.00) were sampled from a number of universities in the UK and internationally via social media posts circulated at regular intervals during the data collection period. Participants competed in a wide range of sports (N = 27), with the most common team-based sports being soccer (n = *57*), rugby (n = 16), volleyball (n = 12), and basketball (n = 8), and the most common individually-based sports being swimming (n = 13), martial arts (n = 12), tennis (n = 10), and boxing (n =

9). The current competitive level of the participants ranged from amateur (n = 183) to professional/international level athletes (n = 18). The study participants had been competing in their respective sports for an average of 8.97 ± 6.29 years.

Measures

Individual characteristics. The study participants provided the research team with information regarding their age, gender, primary sport, current competitive level, and years of playing experience.

Pittsburgh Sleep Quality Index. The Pittsburgh Sleep Quality Index (PSQI; Buysse, Reynolds, Monk, Berman, & Kupfer, 1989) was used to assess the perceived sleep quality of the athlete participants. The PSQI comprises 19 items with 7 components related to sleep habits over a one-month period prior to completion: subjective sleep quality (1 item), sleep latency (2 items), sleep duration (1 item), habitual sleep efficiency (3 items), sleep disturbances (9 items), use of sleeping medication (1 item), and daytime dysfunction (2 items). All component scores are calculated using specific scoring instructions (see Buysse et al.), with scores ranging from 0 (no difficulty) to 3 (severe difficulty) for each component. A global score can also be calculated for the PSQI by combining the seven component scores, with a range of 0 (no difficulty) to 21 (severe difficulty) for this global index. The PSQI has demonstrated good internal reliability and test-retest reliability in clinical and non-clinical settings (see Mollayeva et al., 2015 for a meta-analysis).

Sport Imagery Ability Questionnaire. The Sport Imagery Ability Questionnaire (SIAQ; Williams & Cumming, 2011) was used to assess the ability of respondents to image different types of imagery content. The questionnaire comprises 15 items with 5 subscales related to different types of imagery ability: skill (3 items), strategy (3 items), goal (3 items), affect (3 items), and mastery (3 items). Participants rated their ease of imaging for each item using 7-point likert scale anchored by 1 (very hard to image) and 7 (very easy to image). The scale underwent extensive validation during initial design comprising of 1 exploratory factor analysis, 2 progressive confirmatory factor analysis, and a final study examining the scales construct validity alongside the Movement Imagery Questionnaire-3 (MIQ-3; Williams, Cumming, Ntoumanis, Nordin-Bates, Ramsey, & Hall, 2012). In the final study, the scale showed robust goodness of fit indices ($\chi 2$ (80) = 108.59, $p < .05$, CFI = .98, TLI = .97, SRMR = .04, RMSEA = .04) and satisfactory levels of composite reliability for all 5 subscales (.78-.86). In this study, satisfactory Cronbach alpha scores were reported for the SIAQ (global = .88), with questionable to good scores reported for the subscales of this measure (skill = .73, strategy = .60, goal = .82, affect = .80, mastery = .68).

Procedure

Ethical approval was granted by the lead authors university ethics committee and all participants provided informed consent prior to taking part in the study. An online survey pack was developed using an online-survey provider (www.surveymonkey.com). The survey pack contained a participant consent form, demographic questionnaire, PSQI, SIAQ, and participant debrief form (presented in that order). Prior to involvement in the study, all participants were notified that engagement with this study was voluntary, they had the right to withdraw at any time during/after the study, and that the information provided would be treated confidentially and stored securely on password-protected computers for all research team members. The online questionnaire took approximately ten minutes to complete in full.

Data Analyses

All statistical procedures were conducted using a minimum significance level of $p = .05$. First, data were screened for univariate normality, multivariate normality, and multicollinearity. Second, regression analyses were run to explore the direction and relative contribution of sleep quality towards variance in imagery ability. Specifically, simple regression analyses were used to examine whether the global PSQI score predicted SIAQ scores (global, five subscales), and forced entry multiple regression analyses were used to examine whether the seven PSQI component scores predicted SIAQ scores (global, five subscales).

Results

Data Screening

For the final study sample, there were no missing values. Cook's distances were used to examine the assumptions of multivariate normality, with a value greater than 1 indicative of multivariate outliers (cf. Cook & Weisberg, 1982). For all regression analyses, Cook's distance values were below 1 with a maximum value of 0.16 (M = 0.01, SD = 0.01), indicating that no single case greatly influenced the respective models, leaving 201 cases for each analysis. The variance inflation factor values were all below 10 with a maximum value of 1.76 (M = 1.31, SD = 0.23) and the tolerance statistic scores were all above 0.20 with a minimum value of 0.68 (M = 0.78, SD = 0.12), indicating no collinearity within the data. Pearson's correlations were used to account for potential variance in sleep quality as a function of 'years played' (r =.08) and 'highest level played' (r = .03) and indicated no significant relationship between any of these variables (p > .05).

[INSERT TABLE 1 HERE]

Global Sleep Quality: Imagery Ability

The relationship between global sleep quality and imagery ability was assessed using six regression analyses. The first simple regression analysis identified that the global sleep quality score accounted for 1.10% of variability in the global imagery ability score (β = -.11, R^2 change = .01, $F_{1\text{-}199}$ = 2.29, p > .05). Further simple regression analyses identified that the global sleep quality score predicted affect imagery ability score, but not scores for the four other imagery ability subscales. Specifically, global sleep quality score accounted for 0.30% of variability in skill imagery ability (β = -.05, R^2 change = .01, $F_{1\text{-}199}$ = 0.59, p > .05), 0.00% of variability in strategy imagery ability (β = -.00, R^2 change = .00, $F_{1\text{-}199}$ = 0.00, p > .05), 0.80% of variability in goal imagery ability (β = -.09, R^2 change = .01, $F_{1\text{-}199}$ = 1.64, p > .05), 2.70% of variability in affect imagery ability (β = -.16, R^2 change = .03, $F_{1\text{-}199}$ = 5.47, p < .05), and 0.60% of variability in mastery imagery ability (β = -.08, R^2 change = .01, $F_{1\text{-}199}$ = 1.17, p > .05).

Components of Sleep Quality: Imagery Ability

The relationship between the components of sleep quality and imagery ability was assessed using six multiple regression analyses. The first multiple regression analysis reported that the sleep quality components accounted for 14.00% of variability in global imagery ability. Daytime dysfunction (β = -.28, R^2 change = .14, $F_{7\text{-}193}$ = 4.47, p < .001) and use of sleeping medication (β = -.15, R^2 change = .14, $F_{7\text{-}193}$ = 4.47, p < .05) were identified as significant predictors towards the global imagery ability score. All other sleep quality components were not significant predictors of global imagery ability (p > .05).

[INSERT TABLE 2 HERE]

The second multiple regression analysis reported that the sleep quality components accounted for 9.90% of variability in skill imagery ability. Daytime dysfunction (β = -.23, R^2 change = .10, $F_{7\text{-}193}$ = 3.03, p < .01) was identified as the only significant predictor towards the skill imagery ability score. All other sleep quality components were not significant predictors of skill imagery ability (p > .05).

[INSERT TABLE 3 HERE]

The third multiple regression analysis reported that the sleep quality components accounted for 9.00% of variability in strategy imagery ability. Daytime dysfunction (β = -.24, R^2 change = .09, $F_{7\text{-}193}$ = 2.72, p < .01) was identified as the only significant predictor towards the strategy imagery ability score. All other sleep quality components were not significant predictors of strategy imagery ability (p > .05).

[INSERT TABLE 4 HERE]

The fourth multiple regression analysis reported that the sleep quality components accounted for 8.30% of variability in goal imagery ability. Use of sleeping medication (β = -.16, R^2 change = .08, $F_{7\text{-}193}$ = 2.51, p < .05) was identified as the only significant predictor towards the goal imagery ability score. All other sleep quality components were not significant predictors of goal imagery ability (p > .05).

[INSERT TABLE 5 HERE]

The fifth multiple regression analysis reported that the sleep quality components accounted for 13.00% of variability in affect imagery ability. Daytime dysfunction (β = -.21, R^2 change = .13, $F_{7\text{-}193}$ = 4.12, p < .01) and use of sleeping medication (β = -.26, R^2 change = .13, $F_{7\text{-}193}$ = 4.12, p < .001) were identified as significant predictors towards the global imagery ability score. All other sleep quality components were not significant predictors of goal imagery ability (p > .05).

[INSERT TABLE 6 HERE]

The sixth multiple regression analysis reported that the sleep quality components accounted for 10.80% of variability in mastery imagery ability. Daytime dysfunction (β = -.33, R^2 change = .11, $F_{7\text{-}193}$ = 3.32, p < .001) was identified as the only significant predictor towards the mastery imagery ability score. All other sleep quality components were not significant predictors of mastery imagery ability (p > .05).

[INSERT TABLE 7 HERE]

Discussion

The aim of the current study was to examine the predictive capabilities of sleep quality towards imagery ability in an athletic population. Specifically, we examined whether athlete sleep quality predicted imagery ability in athletes. It was hypothesized that sleep quality (global & seven components) would positively predict imagery ability (global & five types). The study findings provide partial support of this hypothesis. Somewhat surprisingly, global sleep quality did not predict global imagery ability, and only held a predictive relationship with affect imagery ability. This suggests that athletes who have higher overall quality of sleep tend to be more able to generate imagery with content directed towards the positive emotions associated with participation in sport (e.g., excitement, happiness). It is consistently reported that sleep, and more specifically sleep deprivation, impacts negatively upon a person's emotional states (e.g., Paterson et al., 2011), emotional regulation (e.g., Baum et al., 2014), perception of emotions (e.g., Daniela, Alessandro, Giuseppe, Fabio, & Cristina, 2010), and ability to express emotions (Minkel, Htaik, Banks, & Dinges, 2011). In combination, these findings suggest that if an athlete has a high quality of sleep they are likely to be able to understand and express emotions more accurately. Given that affect imagery involves the generation of images of positive emotions related to sport, it is conceivable that sleep will impact upon an athlete's ability to generate this imagery type through its relationship with emotion.

When exploring the predictive relationship between the seven components of sleep quality and imagery ability, it was found that daytime dysfunction and use of sleeping medication are the only two predictors of imagery ability types. Specifically, daytime dysfunction predicted global, skill, strategy, affect, and mastery imagery ability, and use of sleeping medication predicted global, goal, and affect imagery ability. It is surprising that just two of seven sleep quality components predict imagery ability due to the apparent relationship between sleep, mental imagery and memory. However, these findings may be partially explained by the general sleep characteristics of the sample used in this study. Leeder et al. (2012) report that sleep quality and quantity are worse for elite athletic compared to non-athletic populations, whereas a study by Selby, Weinstein and Bird (1990) found that 68% of student athletes reported that they got sufficient sleep for a maximum of two nights per week. Based on these studies, it is understandable that on average our athlete cohort are diagnosed to have sleep disorder (*M* = 6.05) based on general population guidelines (Buysse et al., 1989). This disordered sleeping is likely to be a long-term issue which may be seen as ‘the norm’ for this population type. It is possible that the athletes in this study do not believe their sleep duration or sleep quality to be ‘non-normal’ unless they perceive it to impact upon their actual behavior (i.e., daytime functioning or use of medication). Everyday functioning in sport incorporates both cognitive and physical tasks, with athletes using all types of imagery fairly frequently within their sporting involvement (e.g., Gregg, Hall, & Nederhof, 2005). The use of sleeping medication is said to impact daytime functioning through cognitive and/or physical impairment (e.g., Verster, Veldhuijzen, & Volkerts, 2004), outlining the impact that this can have upon subsequent behavior, including the effective application of imagery.

The study findings lend partial support to Cumming and Williams’ (2012) adaptation of the “who” component in the revised applied model of deliberate imagery use, whereby greater importance is placed on the individual performing the imagery. A multitude of individual characteristics are reported to influence imagery function, effectiveness, and the outcomes associated with its use (Cumming & Williams, 2013). Our results show that global sleep quality and specific components of sleep quality (daytime dysfunction, use of sleep medication) impact upon different types of imagery ability in sport. It is possible that poor sleep quality will reduce an athlete’s ability to recall memories, function cognitively, and understand emotions, all important aspects of imagery development in sport. This finding outlines the potential importance of physiological variables as a separate category of individual differences for imagery use in sport, exercise, rehabilitation, and dance. All of these domains require some form of physical and mental exertion, suggesting a need to better understand the relationships between physiological states and imagery. Specifically, there is a need to consider recovery-based indicators such as fatigue, hydration status, and injury/illness when applying imagery interventions and monitoring the outcomes associated with imagery use.

This study undoubtedly has its merits, including the recruitment of a split-gender sample of athletes from a wide variety of sports, and the extensive psychometric assessment of sleep quality and imagery ability in sport. However, a number of limitations exist surrounding the cross-sectional design and assessment methods used in this study. First, we did not account for the influence of experimental demands on the results, whereby participants may have guessed the study aims and answered questions accordingly. Similarly, as the PSQI was presented to participants before the SIAQ, an acknowledgement of sleep dysfunction might have biased answers to the SIAQ. Correlation analysis to examine the relationship between participants' expectation about the study and the actual results would have been useful to check this (see Holmes, Mathews, Mackintosh, & Dagleish, 2008).

Second, although our design allowed the research team to examine the relationship between sleep quality and imagery ability across a relatively large sample of athletes, it does not permit understanding of causality. In this respect, there is a need to explore the interrelations between sleep and imagery in greater depth. For instance, research is warranted examining whether interventions targeting better quality sleep also improve an athlete's ability to image and his/her subsequent effectiveness of imagery use. One such intervention that has been used with athletes is sleep extension, which involves the employment of a strict sleep regime with a minimum sleep duration over an extended period of time (see e.g., Mah, Mah, Kezirian, & Dement, 2011). Additionally, there is a need to consider the recursive relationship that may exist between sleep and imagery ability by exploring the use of imagery-based training methods such as layered stimulus response training to improve sleep quality in athletic populations (see Cumming et al., 2016). The recommended study foci should incorporate multi-modal assessment of both sleep quality and imagery ability as appropriate within the specific study designs. Alternative methods used to assess sleep quality include sleep diaries and wrist activity monitors (e.g., Sargent, Lastella, Halson, & Roach, 2014), whilst imagery ability has been measured objectively using physiological and behavioral measures such as electroencephalography (Cremades & Pease, 2007), functional magnetic resonance imaging (Cui, Jeter, Yang, Montague, & Eagleman, 2007), and electromyography (Wilson et al., 2010).

In summary, this study extends the literature on the "who" component of Cumming and Williams' (2012) revised applied model of deliberate imagery use by exploring the relationship between sleep quality and imagery ability in athletes. Data analyses revealed that global sleep quality predicted affect imagery ability, and that two components of sleep quality (daytime dysfunction and use of sleep medication) predicted global imagery ability and various imagery ability types. The findings of this study suggest that different physiological factors are associated with differences in sport imagery ability in athletic populations, thus providing support for Cumming and Williams' assertions that individual characteristics warrant consideration when attempting to apply imagery affectively. Future studies should explore the interrelations between sleep and imagery ability by attempting to manipulate either variable and assessing the impacts upon both.

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Table 1

Mean and standard deviation values for sleep quality and sport imagery ability scores

	M	SD
Pittsburgh Sleep Quality Index		
Subjective Sleep Quality	1.13	0.75
Sleep Latency	1.44	0.90
Sleep Duration	0.40	0.72
Habitual Sleep Efficiency	0.45	0.82
Sleep Disturbances	1.35	0.52
Use of Sleeping Medication	0.15	0.57
Daytime Dysfunction	1.13	0.72
Global Sleep Quality	6.05	2.90
Sport Imagery Ability Questionnaire		
Skill Imagery Ability	4.42	0.90
Strategy Imagery Ability	4.23	0.87
Goal Imagery Ability	4.07	1.26
Affect Imagery Ability	4.84	1.02
Mastery Imagery Ability	4.15	0.97
Global Imagery Ability	4.34	0.76

Table 2

Summary of multiple regression analysis for sleep quality components predicting global imagery ability score in athletes

	B	B_{SE}	*β*
Constant	4.70	0.16	
Subjective Sleep Quality	0.06	0.09	.06
Sleep Latency	0.10	0.06	.11
Sleep Duration	-0.04	0.09	-.04
Habitual Sleep Efficiency	0.11	0.07	.12
Sleep Disturbances	-0.16	0.11	-.11
Use of Sleeping Medication	-0.20	0.09	-.15*
Daytime Dysfunction	-0.30	0.08	-.28***

Note: B = Unstandardised Beta Coefficient, B_{SE} *= Standard Error of B, β = Standardised Beta Coefficient. N = 201,* R^2*=0.14, Adjusted* R^2*= 0.11,* $F_{7\text{-}193}$ *=4.47, (** $p < 0.05$*, **** $p < 0.001$*).*

Table 3

Summary of multiple regression analysis for sleep quality components predicting skill imagery ability score in athletes

	B	B_{SE}	*β*
Constant	4.64	0.19	
Subjective Sleep Quality	0.04	0.11	.03
Sleep Latency	0.14	0.07	.14
Sleep Duration	-0.12	0.10	-.09
Habitual Sleep Efficiency	0.16	0.09	.15
Sleep Disturbances	-0.10	0.13	-.06
Use of Sleeping Medication	-0.13	0.11	-.09
Daytime Dysfunction	-0.29	0.10	-.23**

Note: B = Unstandardised Beta Coefficient, B_{SE} *= Standard Error of B, β = Standardised Beta Coefficient. N = 201,* R^2*=0.10, Adjusted* R^2*= 0.07,* $F_{7\text{-}193}$ *=3.03, (** p < 0.01).*

Table 4

Summary of multiple regression analysis for sleep quality components predicting strategy imagery ability score in athletes

	B	B_{SE}	β
Constant	4.50	0.19	
Subjective Sleep Quality	0.12	0.11	.11
Sleep Latency	0.10	0.07	.10
Sleep Duration	0.05	0.10	.04
Habitual Sleep Efficiency	0.08	0.08	.07
Sleep Disturbances	-0.19	0.13	-.11
Use of Sleeping Medication	-0.11	0.11	-.07
Daytime Dysfunction	-0.29	0.09	-.24**

*Note: B = Unstandardised Beta Coefficient, B_{SE} = Standard Error of B, β = Standardised Beta Coefficient. N = 201, R^2=0.09, Adjusted R^2= 0.06, $F_{7\text{-}193}$ =2.72, (** $p < 0.01$).*

Table 5

Summary of multiple regression analysis for sleep quality components predicting goal imagery ability score in athletes

	B	B_{SE}	β
Constant	4.60	0.27	
Subjective Sleep Quality	-0.07	0.15	-.04
Sleep Latency	0.12	0.10	.09
Sleep Duration	-0.03	0.15	-.01
Habitual Sleep Efficiency	0.19	0.12	.12
Sleep Disturbances	-0.33	0.18	-.14
Use of Sleeping Medication	-0.35	0.16	-.16*
Daytime Dysfunction	-0.18	0.14	-.10

*Note: B = Unstandardised Beta Coefficient, B_{SE} = Standard Error of B, β = Standardised Beta Coefficient. $N = 201$, $R^2=0.08$, Adjusted $R^2= 0.05$, $F_{7-193}=2.51$, (** $p < 0.01$).*

Table 6

Summary of multiple regression analysis for sleep quality components predicting affect imagery ability score in athletes

	B	B_{SE}	*β*
Constant	5.21	0.21	
Subjective Sleep Quality	-0.00	0.12	-.00
Sleep Latency	0.09	0.08	.08
Sleep Duration	-0.06	0.12	-.04
Habitual Sleep Efficiency	0.08	0.09	.06
Sleep Disturbances	-0.08	0.14	-.04
Use of Sleeping Medication	-0.46	0.12	-.26***
Daytime Dysfunction	-0.30	0.11	-.21**

Note: B = Unstandardised Beta Coefficient, B_{SE} *= Standard Error of B,* β *= Standardised Beta Coefficient.* $N = 201$, R^2=0.13, *Adjusted* R^2= 0.10, $F_{7\text{-}193}$ =4.12, *(**$p < 0.01$, ***$p < .001$).*

Table 7

Summary of multiple regression analysis for sleep quality components predicting mastery imagery ability score in athletes

	B	B_{SE}	*β*
Constant	4.55	0.21	
Subjective Sleep Quality	0.19	0.12	.15
Sleep Latency	0.03	0.08	.03
Sleep Duration	-0.05	0.11	-.04
Habitual Sleep Efficiency	0.05	0.09	.04
Sleep Disturbances	-0.12	0.14	-.07
Use of Sleeping Medication	0.05	0.12	-.03
Daytime Dysfunction	-0.45	0.10	-.33***

*Note: B = Unstandardised Beta Coefficient, B_{SE} = Standard Error of B, β = Standardised Beta Coefficient. N = 201, R^2=0.11, Adjusted R^2= 0.08, $F_{7\text{-}193}$ =3.32, (*** $p < .001$).*

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